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90185

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Level 1 Physics, 2004

90185 Demonstrate understanding of electricity and magnetism

Credits: Five
9.30 am Thursday 18 November 2004

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should answer ALL the questions in this booklet.

For all numerical answers, full working must be shown. The answer should be given with an SI unit.

For all 'describe' or 'explain' questions, the answer should be in complete sentences.

Formulae you may find useful are given on page 2.

If you need more space for any answer, use the pages provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–10 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Achievement Criteria *For Assessor's use only*		
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Identify or describe aspects of phenomena, concepts or principles. ☐	Give descriptions or explanations in terms of phenomena, concepts, principles and/or relationships. ☐	Give concise explanations that show clear understanding in terms of phenomena, concepts, principles and/or relationships. ☐
Solve straightforward problems. ☐	Solve problems. ☐	Solve complex problems. ☐
Overall Level of Performance (all criteria within a column are met) ☐		

You are advised to spend 50 minutes answering the questions in this booklet.

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You may find the following formulae useful.

$$V = IR \qquad P = IV \qquad P = \frac{E}{t} \qquad R_T = R_1 + R_2 + \ldots$$

$$B = \frac{\mu_0}{2\pi}\frac{I}{d}$$

QUESTION ONE: STATIC ELECTRICITY

Mark rubs a polythene rod with a piece of wool. The wool becomes **positively** charged.

(a) State the type of charge on the polythene rod.

(b) Using the idea of charges, explain clearly how the **polythene rod** becomes charged.

(c) Now Mark rubs a **copper rod** with a piece of wool and notices that it cannot be charged. Explain why.

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Kelly suspends a small **uncharged** polystyrene ball coated with metallic paint as shown in Diagram 1. When she brings a **positively charged** rod near to the suspended ball, she notices that the ball starts moving towards the rod as shown in Diagram 2. The ball touches the rod (Diagram 3) and then it moves away from the rod (Diagram 4).

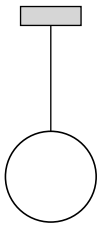

Diagram 1

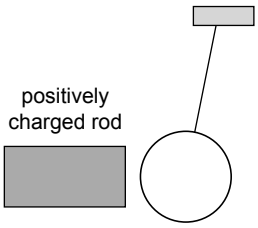

Diagram 2

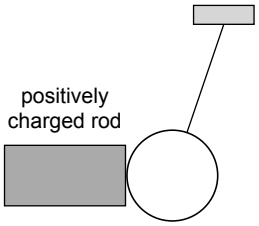

Diagram 3

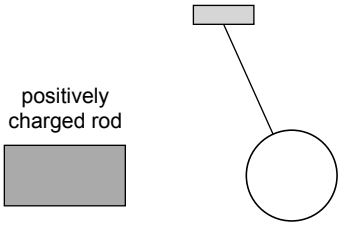

Diagram 4

(d) On Diagram 2 draw in the **charge distribution** on the sphere.

(e) Explain why the ball is **initially attracted** to the rod as shown in Diagram 2.

(f) Diagram 3 shows the ball is being attracted to the rod. The next instant, it is repelled away from the rod as shown in Diagram 4. Explain why.

(g) On Diagram 4 draw in the **charge distribution** on the sphere.

(h) When Kelly **very** gently touches the ball in Diagram 4 with her finger, the ball swings back to the position shown in Diagram 2. Explain why.

QUESTION TWO: WIRING A FOG LAMP

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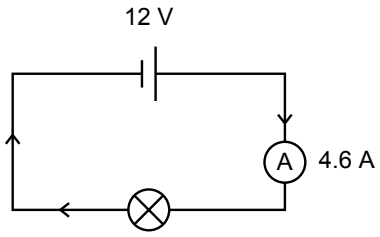
Sio bought a new 12 V bulb for the headlight on his motorbike. He tests the bulb by connecting it in series with a **12 V** battery and an ammeter as shown in the diagram. The current through the ammeter is **4.6 A.**



(a) Calculate the **resistance** of the lamp.

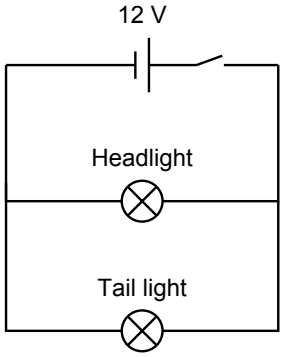
Resistance = _____

(b) Show that the power output of the bulb is approximately **55 W**.

(c) Calculate the amount of energy supplied by the battery when the bulb is turned on for **2 minutes.**

Energy = _____

Sio now puts the bulb into the headlight socket of the bike. When he turns the switch on, both the headlight and the tail light are turned on. Both lights are operated from the 12 V battery at their full brightness. The circuit diagram below shows the wiring of the lights to the battery.



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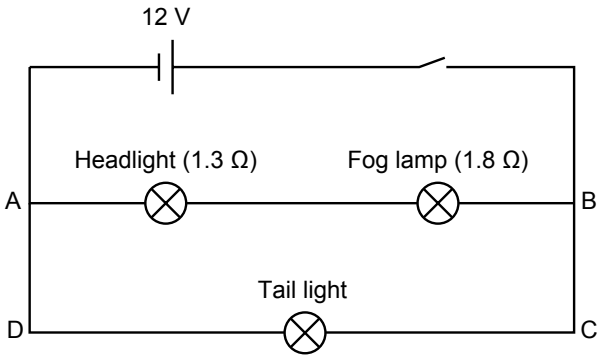
(d) The power output of the tail light is **18 W.**

Calculate the **resistance** of the tail light**.**

Resistance = _____

Sio fits a fog lamp to his bike. He wires a '12 V' fog lamp into the existing circuit as shown below. He now turns the switch on and notices that the fog lamp is **not** at its full brightness.



(e) Explain why the fog lamp is not at its **full** brightness.

(f) The working resistance of the headlight is **1.3 ohms** and that of the fog lamp is **1.8 ohms.**

Show that the current through branch AB of the circuit is **3.9 A.**

(g) Find the **voltage** across the fog lamp.

Voltage = _____

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(h) The power output of the tail light is 18 W. Calculate the combined value of the current through both branches and use this value to find the **total effective resistance** of the circuit.

Total resistance = _____

(i) Sio's uncle now connects all the three bulbs in parallel with the 12 V battery. When Sio closes the switch the three bulbs are all lit at their full brightness. The working resistance of the fog lamp, when it is fully lit, is 3.2 ohms.

Calculate the **power** output of the fog lamp.

Power = _____

QUESTION THREE: THE ELECTROMAGNETIC DOOR LOCK

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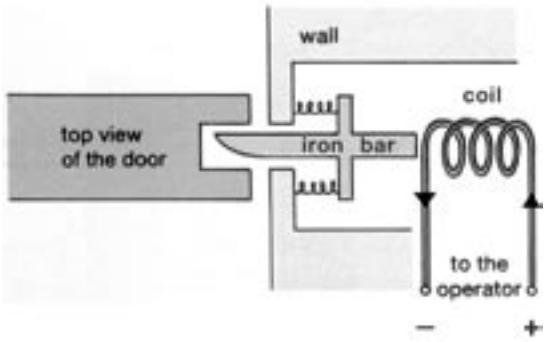
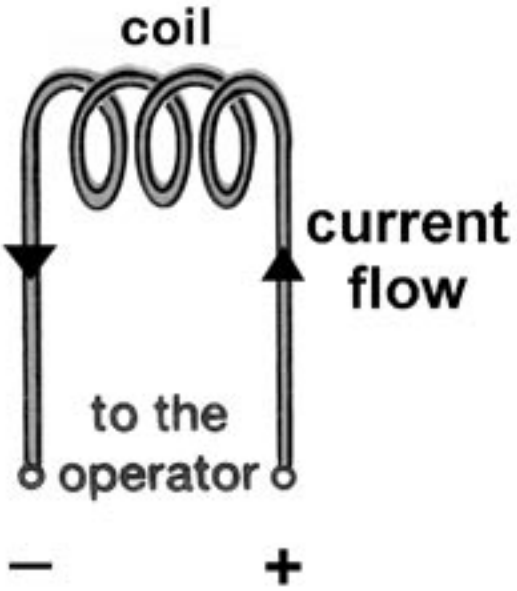
The diagram shows the **top view** of a security door lock mechanism. The iron bar keeps the door locked.



(a) When the security guard presses the switch, a current flows through the coil. On the diagram below, use the letters **'N** 'and **'S'** to label the north and the south poles of the coil.



(b) On the same diagram, draw the **shape** of the magnetic field formed **inside** the coil. Use arrows to indicate the **direction** of this magnetic field.

(c) Explain how the door unlocks when the switch is closed.

_____

_____

_____

The wire that connects the coil to the power supply carries a current upwards as shown below.

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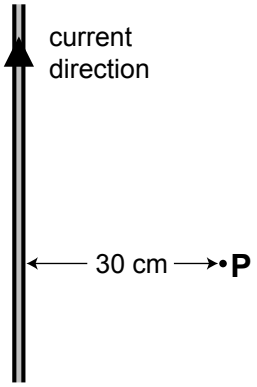

(d) On the diagram above, draw the **shape** of the magnetic field produced by the current. Use arrows to show the **direction** of the magnetic field.

The point 'P' is **30 cm** away from the cable and, when the switch is closed, the current through the cable is **5.0 amps.** The value of μ_o is 1.26 x 10^{-6} Tm A^{-1}.

(e) Calculate the **size** of the magnetic field at point P. Give the correct **unit** with your answer.

Size of the magnetic field = _____ _____ (unit)

Extra paper for continuation of answers if required.
Clearly number the question.

Question number

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